



# Iowa Department of Transportation

## SPECIAL PROVISIONS FOR STREET LIGHTING

Polk County  
TAP-T-8477(613)--8V-77

Effective Date  
May 19, 2015

**THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.**

### **PART 1 - GENERAL**

#### 1.1 SCOPE

- A. This Special Provision, and the sections herein, governs the furnishing of all material, equipment, and labor for the installation and testing of a complete, operational street lighting system, including power to miscellaneous equipment noted. All material and equipment supplied, and all work performed, shall be in accordance with these Special Provisions, and as shown on the Plans.

#### 1.2 CODES AND STANDARDS

- A. In addition to the requirements of the Plans and the Special Provisions, all material and work shall conform to the requirements of the 2008 National Electrical Code (ANSI/NFPA 70), the National Electrical Safety Code (ANSI C2), and the standards of the American Society for Testing Materials (ASTM) and the American Standards Associations (ASA), and local ordinances. All electrical equipment shall conform to the standards of the National Electrical Manufacturers Association (NEMA).

#### 1.3 REVISION OF STANDARD SPECIFICATIONS

- A. When reference is made to a standard specification (NEMA, ASTM, ASA, ANSI, IES, IPCEA, UL, AASHTO, FSS, etc.), the standard specification referred to shall be construed to mean the latest revision of said standard specification, as amended, that is in effect on the date the Plans are approved, except as otherwise shown on the Plans or specified in the Special Provisions.

#### 1.4 PLANS

##### A. Incidental Parts

1. All incidental parts, which are not shown on the Plans or specified herein and which are necessary to complete the street lighting system, shall be supplied and installed as though such parts were shown on the Plans or specified herein. All systems shall be complete and in operation to the satisfaction of the City and Engineer at the time of acceptance of the work.

##### B. Appurtenances

1. All appurtenances shall be installed as shown on the Plans, or as specified in the Special Provisions. Any deviations must be established and authorized by the Engineer in the field.

##### C. As-Built Plans

1. Prior to the acceptance of the work, the Contractor shall submit an "As-Built" or corrected plan showing in detail all construction changes, especially the location and depth of the conduit.

#### 1.5 SHOP DRAWINGS

- A. Before commencing the installation of any material or equipment, the Contractor shall submit two copies of complete shop drawings for manufactured materials and equipment to the Engineer for approval. Manufacturers' bulletins, leaflets and other descriptive data that contain cuts, dimensions, specifications and wiring diagrams will be acceptable for standard cataloged equipment. Such bulletins, leaflets and other descriptive data shall be clearly marked to show the item to be used to satisfy a required item in the schedule of materials shown on the Plans, or as specified in the Special Provisions. The Engineer may require other descriptive data, drawings, and diagrams for non-cataloged equipment or materials. In the event any items of material or equipment contained on the shop drawings fail to comply with the specification requirements, such items may be rejected by the Engineer. Orders for material and equipment shall not be placed until written approval is obtained from the Engineer.

B. Provide shop drawings for the following:

1. Luminaires and standards.
2. Controllers and accessories.
3. Junction boxes/hand holes.
4. Cable splices and connections.
5. Solar array.
6. Inverter.

#### 1.6 ELECTRICAL PERMITS AND INSPECTIONS

- A. The Contractor is responsible for obtaining an electrical permit from the City before any excavation for the control center foundation or the service feed takes place. The Contractor shall contact the City for an electrical inspection when the control center is ready.
- B. The Contractor is responsible for obtaining such permits and approvals as may be required by the appropriate electrical utility company and is responsible for all costs associated with extending electrical power from the service point to the control center whatever the distance. The Contractor shall notify the appropriate electrical utility company ahead of when the system needs to be energized.

- C. The City will assign an address for the control center, which the Contractor shall use when obtaining permits and when dealing with the electrical utility company.
- D. The Contractor shall contact the Engineer once project work begins including; trenching and pole installations and to request final project inspections.

1.7 SYSTEM TESTING

- A. The Contractor is responsible for testing the completed street lighting system. Prior to acceptance by the Engineer, the Contractor shall notify the Engineer for an inspection as soon as the system(s) is (are) ready.
- B. All street lighting system elements shall function properly as a complete system for a minimum period of 15 days before acceptance by the Engineer. The 15 day period shall be continuous and initiated by the inspector. Any malfunction observed or recorded shall stop the test period as of the time of the malfunction. A period shall start when the malfunction has been repaired to the satisfaction of the inspector.

1.8 MAINTENANCE WORK

- A. The Contractor is responsible for making all repairs and replacements, including, downed poles, damaged or cut cables, and burnt out lamps, to the street lighting system, regardless of the cause or responsible party, until the entire system is completed, inspected and accepted by the Engineer.

1.9 GUARANTEE

- A. Fully guarantee the street lighting installation against defective equipment and materials for 24 months. If defects develop under normal operating conditions within these specified periods after acceptance of the completed installation by the Engineer, the defects shall be corrected by, and at the expense of the Contractor.

**PART 2 - MATERIALS AND EQUIPMENT**

2.1 GENERAL

- A. This section governs all luminaires, poles, conduits, cables and other material and equipment supplied by the Contractor as required to complete the street lighting system as shown on the Plans and as specified in the Special Provisions. All lighting equipment shall be new and of the best grade and shall be approved by the Engineer.

2.2 STANDARDS

- A. The type of pole and length of luminaire arm (if any) shall be as specified on the plans.
- B. Pole assembly shall be capable of withstanding winds up to 80 mph with a 1.3 gust factor without failure.
- C. The surface of the pole shall have a smooth finish. The finish color for the standard, arms and base covers shall be black. Finish coating shall be electrostatically applied semi-gloss, polyester powder coat.

- D. Base Cover/Joint Cover: Cast aluminum base and joint cover shall clamp around the pole assembly using stainless steel hardware.
- E. Maintenance Opening: A 4 inch by 10 inch opening shall be provided in the pole shaft for wiring. Secure cover with stainless steel hardware.
- F. Banner Arms: Dual banner arm mounts suitable for an 18 inches wide, 48 inches long banner.

### 2.3 FOUNDATIONS

- A. Construct cast-in-place concrete foundations for all lighting standards. Form and pour the top portion of all foundations in form work to at least 6 inches below the finished ground level. Ensure the foundations conform in all respects to the details including reinforcement as shown on the Plans. Pre-cast bases meeting the project requirements shall also be acceptable.
- B. Ensure finished surfaces are smooth are free from stains and foreign materials.
- C. Anchor bolts shall be threaded a minimum of 6 inches at one end and have a 4 inch long, 90 degree bend at the other end.
- D. Place anchor bolts to provide for placement of nuts and washers on the top and bottom of the pole flange, leaving ample room for adjustment and plumbing the standard. After leveling the poles, expansive type grout shall be troweled between the pole base and the foundation for gaps of 1 inch or greater. Exposed edges of grout shall be neatly finished. Place a weep hole in the grout.

### 2.4 ILLUMINATION EQUIPMENT

- A. The manufacturer, type and model of approved, acceptable luminaires shall be supplied as shown on the Plans.

### 2.5 SOLAR ARRAY

- A. The manufacturer, type and model of approved, acceptable solar array shall be supplied as shown on the Plans.
- B. Metals: Aluminum sheets and plates used in the construction of modules shall be compliant to ASTM B209.
- C. Backsheet: Thin polymer sheets to be used which provide the following key functions:
  - 1. Physical protection from puncture and abrasion.
  - 2. Moisture protection and low thermal resistance.
  - 3. Electrical insulation to isolate the cells and connections from the environment.
  - 4. UV and moisture stability over the life of the module. Prevent ingress of water or water vapor.
  - 5. Improve efficiency through optimized internal reflection.
- D. Glass Cover: Anti-reflective tempered glass to be used as the protective shield for the active surface area of the module. To be carefully chosen for high impact and thermal shock resistance.
- E. Encapsulation: The encapsulant shall fill all spaces inside the module and shall adhere to the front glass and the backsheet. The encapsulant should be stable at elevated temperature and high UV exposure.

- F. Cell Material: All the photovoltaic cells within the module are made from crystalline silicon. These cells are produced through advanced printing technology and using proprietary surface texturing to enhance sunlight capture.
- G. Junction Box: Each module shall have a sealed junction box. This box shall not extend more than 1 3/4 inches from the backsheet of the module. This junction box shall contain both the positive and negative output terminal posts. The junction box shall contain a small replaceable cover for easy access for replacement of the blocking diode. The junction box shall be completely filled with a soft, clear, removable, self-healing, room temperature cure, dielectric potting gel leaving no air gaps.
- H. Intercell Connections: Intercell connections contained by the module shall be ready to allow for thermal expansion and to discharge mechanical stress. Intercell electrical contacts to the collector grid contact area of one cell and the back contact area of the next cell shall be provided. These connections shall be designed such that failure of any contact shall not degrade the individual cell electrical output by more than 5% from its output under Standard Test Conditions (STC). Solder shall cover the contact area where the intercell connection overlays the front cell area of one cell and the back contact area of the next cell.
- I. The positive and negative of cell outputs usually drive through the backsheet of the module. After the positive and negative outputs are soldered onto the outside of the solar panel, it is essential to connect the positive and negative outputs with positive and negative output cables inside the Junction Box.

## 2.6 INVERTER

- A. The manufacturer, type and model of approved, acceptable micro inverter shall be supplied as shown on the Plans.
- B. Input power range shall be 210-300W with a maximum input DC voltage of 48V.
- C. Peak output power rating of 250W and continuous rated power output of 240W at 240VAC with a power factor of >0.95.
- D. CEC weighted efficiency of 96.5% at 240VAC.
- E. NEMA 6 enclosure, avoid installation where in direct contact with rain or sunlight.

## 2.7 ELECTRICAL MATERIAL

- A. The types and lengths of cables shall be supplied as shown on the Plans or as specified in the Special Provisions.
- B. Circuits
  1. Unless specifically noted otherwise, install an underground, multiple system roadway lighting circuit that is totally encased in conduit. Construct circuits and control stations according to the Plans.
  2. Ensure circuits are complete with all necessary accessories for proper operation. Thoroughly coordinate disconnecting devices, protective devices, and all other equipment to sure a safe operating lighting system. If any changes in arrangement of the circuit system are considered necessary by the Contractor, submit details of changes and reasons to the City/Engineer for approval. Obtain the City's/Engineer's approval prior to making changes.

- C. Pole Wiring
  - 1. Pole wiring above handhole in pole to luminaire(s) shall be single conductor cable with minimum 600 volt rating, No. 10 AWG Type THHN/THWN. Conductor shall be stranded annealed copper. A grounding conductor shall be No. 6 AWG solid copper wire. NM cable (Romex) is not acceptable.

## 2.8 CONTROL CENTER PEDESTAL

- A. Control center shall be an underground service type, rated for 100 amperes, 120/240 volts, unless otherwise noted. Pedestal shall be stainless steel rain tight construction with individual meter, panel, contactor, HAND/AUTO test switch, receptacle, and photocell. Enclosure shall have piano hinged doors with padlocking provisions. Meter base shall be of the type used by the local utility. Panelboard shall have plated copper buss and shall be configured as shown on the plans. All factory installed wire shall be copper. Control center shall be U.L. listed. Photocell shall be mounted inside the control cabinet with a window in the cabinet facing south for vandal protection. Photocell shall be mounted as close as possible to the window. See approved material listing.

## 2.9 CONDUIT

- A. The type, size and length of conduit and fittings shall be supplied as shown on the Plans or Standard Drawings, or as specified in the Special Provisions.
- B. PVC Conduit Material
  - 1. Rigid nonmetallic conduit shall be 2 inch Schedule 40 polyvinyl chloride (PVC) conduit unless noted otherwise. The conduit shall bear an Underwriters' Laboratories label and shall conform to Federal Specification WC-1094A (latest version). Fittings shall be fabricated from PVS and have the same chemical and physical properties as the conduit with which it is being used. 2 inch Schedule 80 PVC conduit is required under all road and commercial driveway crossings.
- C. HDPE Conduit Material
  - 1. Flexible nonmetallic conduit shall be 2 inch Schedule 40, high-density polyethylene conduit (HDPE). The conduit shall be smooth walled inside and out. The conduit shall be gray in color, and equipped with a polypropylene pull rope. The conduit shall be manufactured to ASTM D2447 specifications and shall meet the following applicable requirements:
    - a. Minimum Wall Thickness: 2 inch Schedule 40 – 0.154 inch
    - b. Tensile Strength: 3,300 psi ASTM D-638
    - c. Elongation: 800 % ASTM D-638
    - d. Density: 60 lbs/cu. ft. ASTM D-1505
    - e. Melt Index: 0.011 oz./10 min. ASTM D-1238(E)
    - f. Brittle Temp.: <-103° F ASTM D-746
    - g. ESCR (Bell Test): >1500 F50 hrs. ASTM D-1693(C)
    - h. Rockwell Hardness L: 49 ASTM D-785
    - i. Shore Hardness D: 61 ASTM D-2240
- D. HDPE Conduit Fittings
  - 1. An approved factory coupling (PNA E-Loc or approved equal) shall be used for connection of the HDPE conduit to a 90 degree factory PVC elbow or between two lengths of HDPE conduit. The coupling shall be of high-density polyethylene. The coupling shall have individual reverse-locking threads with a built-in center stop.

## 2.10 SERVICE AND JUNCTION BOXES

- A. The type and size of service and junction boxes shall be supplied as shown on the Plans. The Contractor may also use precast concrete junction boxes with cast iron covers, reinforced plastic mortar junction boxes, or cast-iron service boxes as may be shown on the Plans.

## PART 3 - CONSTRUCTION REQUIREMENTS

### 3.1 GENERAL

- A. This section governs the construction of all foundations and the installation of all luminaires, poles, conduits, cables and other material and equipment as required to complete the street lighting system as shown on the Plans, the Standard Drawings, and as specified in the Special Provisions. The Contractor is responsible for verifying the correct line and grade of all concrete foundations and conduits prior to installation.

### 3.2 POLE AND LUMINAIRE INSTALLATION

- A. Street light poles and luminaires shall be installed as shown on the Plans and as specified in the Special Provisions or as directed by the Engineer.
- B. Pole Wiring
  1. The luminaire shall be connected to the secondary cables through in-line, waterproof, breakaway fuseholders. All secondary cable connections inside a pole base shall be made with Buchanan (or equal) Y-tap connectors with slipover rubber boots. The Contractor shall install waterproof, breakaway fused tap kits in each pole base. Provide two fused Y-taps for the phase and neutral lead (Buchanan 82S), and one non-fused Y-tap for the ground (Buchanan 83S). Type KTK 5-amp high interrupting fuses, or approved equal, shall be installed. The tap connectors shall be installed convenient to the handhole at the base of the pole. 1 foot of surplus cable shall be coiled at the line side of the tap connector. The connectors for the ground shall be installed with the male end of the connector on the line side.
  2. The ground wires shall be fastened to the factory-installed grounding lug(s) in the base of the pole.
  3. The pole wiring shall be color coded (black/red = hot, white = neutral, green = ground) and without splices from the fuseholder to the connection at the luminaire. Luminaires (post-top) not equipped with terminal blocks shall be connected to the pole wiring with approved butt connectors. Circuit labels shall be installed on the pole wiring.
- C. Pole and Luminaire Erection on a Concrete Foundation
  1. Pole installation shall wait a minimum of 5 days after construction of the foundation. The pole will be mounted to the base using nuts and washers connected to cast-in-place anchor bolts. Using the lower nuts, the pole shall be brought into vertical alignment (plumb), the top nuts tightened, and the anchor bolt covers installed. A luminaire on a gooseneck arm shall project from the street side of the pole and be perpendicular to the curb line. The opening between the pole base and the foundation shall be taped and grouted. Handhole covers shall be situated so that they are on the house side or away from oncoming traffic.
- D. Luminaire Adjustment
  1. The luminaire shall be adjusted and leveled in accordance with the manufacturer's instructions, to place the nadir directly below the light center.

- E. Lamp Installation
  - 1. The installation date shall be marked on the base of the lamp prior to installing it in the luminaire.
- F. Storage and Protection
  - 1. Poles and arms shall be kept dry and out of the weather until time for erection. The manufacturer's protective paper wrapper may be removed for inspection upon receipt from the manufacturer.
- G. Clean Up
  - 1. Poles and luminaires shall be cleaned of dirt, grease, etc. Scratches, abrasions or other surface damage shall be repaired to like new condition.

### 3.3 GROUNDING

- A. Use ground rods and connections to ground major components of the lighting system, such as control stations and lighting standards. Grounding system must have a resistance to ground of 25 ohms or less. Whenever the ground rod installation does not have a resistance to ground of 25 ohms or less, couple additional rods to the first, and drive to the full depth until the required resistance is obtained. If a maximum depth of 50 feet is reached, or if obstacles to further driving are encountered, install additional ground rods until the required resistance to ground is obtained.
- B. Ground rods shall be driven to at least 18 inches below finished grade. Drive ground rods as vertical as possible. The minimum horizontal clearance between all rods in a multiple ground installation is to be 6 feet.

### 3.4 FOUNDATIONS

- A. Foundation anchors shall be of the size and type required for the pole.
- B. Concrete Foundations
  - 1. The bottom of the concrete foundations shall rest on firm ground; foundations shall be poured monolithic. The exposed portions shall be formed to present a neat appearance. Forms shall be true to line and grade. Top of footing for standards, except special foundations, shall be finished to curb, or sidewalk grade or as directed by the City/Engineer. Forms shall be rigid and securely braced in place. Conduit ends and anchor bolts shall be placed in proper position, to proper heights, and held in place by means of a template until the concrete sets. Anchor bolts shall be provided with hex head nut, flat washer and lock washer. Both forms and ground which will contact the concrete shall be thoroughly moistened before placing concrete.
  - 2. Pole base and control center foundations shall be 3500 psi, air entrained, 28-day compressive strength Portland Cement Concrete.
  - 3. Concrete pole bases shall be consolidated by an internal type vibrator. The vibrator shall operate at frequencies of vibration not less than 4500 cycles per minute under load. The amplitude of vibration shall be adequate to consolidate concrete properly. The concrete shall be cured with an approved moisture barrier such as wet burlap, polyethylene, etc., for a period of 72 hours. Cold weather curing shall be such that the concrete temperature shall be maintained above freezing for the entire curing period. Forms shall not be removed until the concrete is thoroughly set.
  - 4. The exposed portions of the foundation shall be finished to present a neat appearance. Finishing should be done with the positioning jig in place. If the jig must be removed for finishing, it shall be re-installed immediately after finishing and left in place throughout the cure period. A safety device (traffic cone, Type I barricade, etc.) shall be installed and secured firmly in place over each foundation immediately after finishing and remain in



place until the pole or pedestal is installed. Prior to installing the pole or pedestal, the positioning jig shall be removed, loose concrete cleaned from around the anchor bolts and conduits, and the conduits trimmed to provide proper clearance for the pole or pedestal.

### 3.5 WIRING

- A. The roadway lighting conductor system shall be installed in HDPE or 2 inch SCH 40 or 80 PVC conduit, wired and installed as a 120 volt system where indicated, required and shown on the Plans. Wiring shall conform to the appropriate articles of the National Electric Code. Wiring shall be continuous from street lighting appurtenance to street lighting appurtenance. No splices of cable will be permitted in conduit or outside of service boxes, junction boxes or pole bases.
- B. Powdered soapstone, talc or other approved lubricant shall be used when inserting conductors in conduit. All cable to be installed in one conduit shall be pulled by the Contractor in one operation, and all ends shall be taped to exclude moisture and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall be taped.
- C. All splices in junction boxes and no service boxes shall be made with appropriate insulated connector block connectors and/or No. 4 AWG copper crimp butt connectors. Splices not factory insulated shall be carefully wrapped with three successive layers of Scotch (3M) No. 130C, "Linerless Rubber Splicing Tape" and then wrapped with three layers of Scotch (3M) No. 33+ "Electrical Tape". The total diameter of the taped splice shall be approximately 1 1/2 times the diameter of the spliced conductor covering. 3M Scotchkote electrical coating shall be "Painted" over the splice. 2 feet of slack shall be left at all control centers, junction boxes and service boxes for splicing and connecting wires. Wiring within boxes shall be neatly arranged and laced up. Wires shall be color-coded (black/red = hot, white = neutral, green = ground) and circuits permanently identified in accordance with designations used on the plans. Color code with tape based on phase (A phase=Black, B phase=Red).
- D. All poles shall be bonded to form a continuous system. At each multiple service point, a ground electrode shall be installed. The electrode shall be a copper rod not less than 5/8 inch in diameter and 8 feet in length, unless otherwise noted on the plans, driven to a depth so the top is 18 inches below the surface of the ground. The service equipment shall be bonded to the driven ground rod by a No. 6 AWG copper wire enclosed in a 1 inch diameter conduit.

### 3.6 SOLAR ARRAY

- A. Insure mounting rails or other type systems are properly secured and able to properly support the modules.
- B. Install in accordance with manufacturer's instructions. Make sure that the module meets the technical requirements of the overall system.
- C. Other system components shall not exert any adverse mechanical or electrical influences on the module.
- D. Try to reduce possibility of corrosive or electrolytic action between metals. Implement care while installing components so as not to damage finish surfaces. Touch up as required to repair damaged finishes. Remove all protective masking from material immediately after installation.

### 3.7 INVERTER

- A. Install in accordance with manufacturer's instructions.
- B. The DC circuit for the model specified is isolated and insulated from ground and does not require a GEC. The unit is compatible with most 60-cell PV modules (to 300W or higher). It works with either three-phase 208 VAC or single-phase 240 VAC services. The unit shall include integrated DC and AC cables and connectors. The DC connectors attach to the PV module, while the AC connector attaches directly to the factory connector cable. No additional cabling is needed.
- C. DO NOT connect or disconnect the PV module and the micro inverter without first removing AC power from the PV system.
- D. DO NOT connect the micro inverter to the utility grid or energize the AC circuit until all of the installation procedures are completed per the installation instructions.
- E. Install the micro inverter under the PV module, out of rain and sun. Do not mount the micro inverter in a position that allows long-term exposure to direct sunlight or in a vertical orientation that allows water to collect in the DC connector recess. Do not install the micro inverter black-side up or vertically, with the DC connectors facing up.
- F. Provide support for all cabling connected to the micro inverter.
- G. Make sure protective sealing caps have been installed on all unused AC connectors. Unused AC connectors are live when the system is energized by the utility system. Sealing caps may not be reused.
- H. Connect the micro inverter to the utility grid only after receiving prior approval from the electrical utility company.
- I. Ensure that all AC and DC wiring is correct. Ensure that none of the AC and DC wires are pinched or damaged. Ensure that all AC junction boxes are properly closed.

### 3.8 CONTROL CENTER PEDESTAL AND FOUNDATION

- A. The control center assembly, including the pedestal, circuit breakers, fuses, contactors, photoelectric control, control wiring, meter socket, service feed, and foundation, shall be constructed and installed as shown on the Plans and as specified in the Special Provisions or as directed by the Engineer. The Contractor shall coordinate his activities with the appropriate electrical utility company to insure delivery of power to the control center when and where required. The control center pedestal shall be cleaned of wrapping, shipping material, dirt, grease, etc. Scratches, abrasions or other surface damage shall be repaired to like new condition. The photo cell shall be directed south unless northbound traffic may impact photo cell operation. Photo cell shall be within 2 inches of window in enclosure.

### 3.9 CONDUIT

- A. All conductors shall be run in conduit between all lighting equipment locations. Conduit shall be installed as shown on the Plans and Standard Drawings, and as specified in the Special Provisions or as directed by the Engineer to avoid underground obstructions. The size of the conduit used shall be as shown on the Plans, and as specified in the Special Provisions. Schedule 80 PVC conduit shall be used under existing and proposed street pavement and commercial driveway approaches. Schedule 40 or schedule 80 PVC or HDPE conduit may be

used at all other locations. It shall be the privilege of the Contractor at his own expense to use larger size conduit if desired; and where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted.

B. Installation

1. The conduit installed under all roadway surfaces shall be placed a minimum of 48 inches below the top of curb elevation; under drives and within shoulders at a minimum depth of 24 inches below finished grade. Street lighting conduit may be installed in the same trench with traffic signal or fiber optic conduit as long as the minimum depth requirements are met and a minimum of 12 inches of vertical separation between the top of one conduit and the bottom of the other is maintained. Conduit set in standard bases shall extend approximately 3 inches above the foundation vertically. Conduit entering through the bottom of a junction box shall be located near the ends to leave the major portion of the box clear. Conduit entering service boxes shall terminate 2 inches inside the box wall and shall be sloped to facilitate pulling of cable. At all outlets, conduit shall enter from the direction of the run.
2. Install a bell end on all conduit terminations in junction boxes and at pole bases.
3. Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air.

C. Trenching

1. A trench crossing a proposed street shall be backfilled with clean 1/2 inch crushed rock (CA-5) to 2 feet behind the future curb. If the bottom of the trench is in rock or rocky soil, the conduit shall be placed on a 6 inch protective layer of clean, tamped backfill material. Backfill within 6 inches of the conduit shall be free of rock or other solid material likely to cause damage. All backfill material shall be compacted to a density at least 90% of the maximum density for the material used as determined by ASTM D-698. The 6 inches of backfill nearest the conduit shall not be machine compacted.

D. Boring

1. Conduit for a power lead-in cable to be placed under an existing developed area outside a street right-of-way shall be installed using approved boring methods. Also, where a conduit is to be placed under an existing paved surface, it shall be installed using approved boring methods. No existing developed property outside a street right-of-way or existing paved surface shall be cut or otherwise disturbed without the written permission of the Engineer and then only in the event insurmountable obstructions are encountered. The conduit shall be bored at a depth of between 24 inches and 36 inches below the final grade. Boring pits shall be kept 2 feet clear of the edge of any type of pavement wherever possible. Excessive use of water, such that the paved surface might be undermined or the subgrade softened, will not be permitted. Boring may be used instead of trenching at all other locations.

3.10 CAUTION TAPE/TRACER WIRE

- A. All underground conduits shall be installed with "DANGER – BURIED ELECTRICAL CONDUIT" red flagging tape 6-inches above conduit. Tape shall be continuous along the conduit run.
- B. Tracer wire shall be installed on all exterior electrical utilities. Trace wire to be 10 gauge minimum stranded copper with yellow thermoplastic insulation recommended for direct burial. Wire connectors to be 3M DBR, or approved equal, and shall be watertight to provide electrical continuity. Tracer wire splices are only allowed in pole bases or handholes. Tracer wire shall be continuous along the conduit run.
- C. The Engineer shall test locate wires before accepting the work. Any damaged locate wires shall be repaired or replaced by the Contractor.

### 3.11 BOXES

- A. Junction boxes shall be installed at the locations shown on the plans. However, boxes shall not be located in sidewalks and driveways. In the unlikely event that a box is placed in a sidewalk or a driveway, a traffic-rated box shall be used. A junction box shall also be installed at each end of a conduit run that crosses the road where direct buried cable begins and ends. The Contractor may install, at his own expense, additional boxes as may be desired to facilitate the work upon approval of the Engineer. Junction boxes shall be installed on 12 inches of crushed rock as shown on the plans or as directed by the Engineer. Unless otherwise directed by the Engineer, boxes shall be installed level to 1 inch above the finish grade.

### 3.12 EXCAVATIONS

- A. The Contractor shall perform all excavations for installing underground conduits, cable, boxes and pole bases in whatever substances encountered, to the depths indicated on the drawings or as otherwise approved. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the excavation to avoid slides. All excavated materials not required or unsuitable for backfill shall be removed and wasted on site obtained by the Contractor.

### 3.13 BACKFILLING

- A. All areas excavated shall be backfilled and compacted in accordance with the Special Provisions and Standards. Backfill shall be deposited in not over 6-inch layers and tamped to 95% density  $\pm$ 3% moisture. The top 6 inches of backfill shall be select soil suitable for sodding. After backfilling, all disturbed areas shall be kept well filled and maintained in a smooth and well-drained condition until permanent repairs are made.

### 3.14 LOCATION

- A. Unless otherwise noted on the plans, or physical obstructions exist, equipment installed on this project shall be located as follows:
  1. Conduit shall be kept a minimum of 1 foot behind the back of curb.
  2. Street light poles shall be installed at least 3 feet behind the back of curb. Handhole covers shall be situated so that they are on the house side or away from oncoming traffic.
  3. Junction boxes shall be installed at least 2 feet behind the back of curb (to center of box) and no closer than 2 feet to any street light pole.
  4. Control centers shall be located in accordance with the applicable City Ordinances.

### 3.15 MEASUREMENT AND PAYMENT

- A. Lighting poles
  1. Measurement and payment for this item shall be made on a per item basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the luminaire, and pole. All fasteners, connectors, and accommodations for electrical stub ups shall be considered incidental to the unit price.
- B. Electrical circuits - #8, #6, #4, #2 THWN copper conductors
  1. Measurement and payment for this item shall be made on a per linear foot basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the wire, pull lubricants, and caution tape/tracer wire. All connectors shall be considered incidental to the unit price.

- C. Controls cabinet
  - 1. Measurement and payment for this item shall be made on a per item basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the controls cabinet. All fasteners, connectors, anchors/pad mount base and accommodations for electrical stub ups shall be considered incidental to the unit price.
- D. Controls cabinet foundation
  - 1. Measurement and payment for this item shall be made on a per cubic foot basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the reinforcing, forms, excavation, and concrete base. All fasteners, connectors, and accommodations for electrical stub ups shall be considered incidental to the unit price.
- E. Handhole
  - 1. Measurement and payment for this item shall be made on a per item basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the handhole. All fasteners, connectors, and accommodations for electrical conduits and conductors shall be considered incidental to the unit price.
- F. S2 fixture
  - 1. Measurement and payment for this item shall be made on a per item basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the luminaire, and driver. All fasteners, connectors, and conductors shall be considered incidental to the unit price.
- G. S3 fixture
  - 1. Measurement and payment for this item shall be made on a per item basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the luminaire, and driver. All fasteners, connectors, and conductors shall be considered incidental to the unit price.
- H. Pole base
  - 1. Measurement and payment for this item shall be made on a per item basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the reinforcing, forms, excavation, and concrete base. All fasteners, connectors, and accommodations for electrical stub ups shall be considered incidental to the unit price.
- I. Ground rod
  - 1. Measurement and payment for this item shall be made on a per item basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the ground rod. All fasteners, connectors, and conductors shall be considered incidental to the unit price.
- J. Solar panel assembly
  - 1. Measurement and payment for this item shall be made on a per item basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the solar panel, racking, protective expanded metal barrier, and micro-inverter. All fasteners, connectors, conductors, labeling, and conduit shall be considered incidental to the unit price.
- K. Disconnect switch
  - 1. Measurement and payment for this item shall be made on a per item basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the lockable recessed switch and finger safe fuse holder. All fasteners, connectors, and conductors shall be considered incidental to the unit price.

- L. Boring
  - 1. Measurement and payment for this item shall be made on a per linear foot basis. Included with this item is all labor, equipment, and materials necessary for boring conduits under existing pavement. All coordination and routing around existing utilities shall be considered incidental to the unit price.
  
- M. Trenching
  - 1. Measurement and payment for this item shall be made on a per linear foot basis. Included with this item is all labor, equipment, and materials necessary for trenching conduits. All coordination and routing around existing utilities shall be considered incidental to the unit price.
  
- N. 2 inch, 1 1/4 inch, 1 inch PVC conduit
  - 1. Measurement and payment for this item shall be made on a per linear foot basis. Included with this item is all labor, equipment, and materials necessary for installing conduits. All fasteners, couplings, and connectors utilities shall be considered incidental to the unit price.
  
- O. 3/4 inch rigid metal conduit
  - 1. Measurement and payment for this item shall be made on a per linear foot basis. Included with this item is all labor, equipment, and materials necessary for installing conduits. All fasteners, couplings, and connectors utilities shall be considered incidental to the unit price.
  
- P. Electrical enclosure
  - 1. Measurement and payment for this item shall be made on a per item basis. Included with this item is all labor, equipment, and materials necessary for furnishing and installing the recessed electrical enclosure, lockable handle, DIN rail, and termination blocks. All fasteners, connectors, anchors, sealing for alterations and accommodations for electrical conduits shall be considered incidental to the unit price.